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IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicants:	T. YOKOYAMA et al.	Conf.:	6887
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For:	GAS GENERATING COMPOSITION		

LETTER SUBMITTING ENGLISH LANGUAGE
TRANSLATION OF NON-ENGLISH PROVISIONAL APPLICATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

March 4, 2004

Sir:

Applicants submit herewith an English translation and a statement that the translation is accurate of Provisional Application No. 60/423,597 filed on November 5, 2002, of which the above-identified U.S. nonprovisional application claims priority under 35 U.S.C. § 119(e).

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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Attachments: Translation of Provisional Application No. 60/423,597 (with Verification of Translation)

Appl. 10/695,759

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: Takushi YOKOYAMA et al.

Serial No.: 60/423 597 Group: Unassigned

Filed: 11/05/2002 Examiner: Unassigned

For: GAS GENERATING COMPOSITION

VERIFICATION OF TRANSLATION

Assistant Commissioner of Patents
Washington, DC 20231

Sir:

I, Takahiko MIZOBE, Chartered Patent Attorney of Furuya & Co., located at 6th Floor, Hamacho-Hanacho Building, 2-17-8, Nihonbashi-Hamacho, Chuo-ku, Tokyo 103-0007, Japan, declare that:

1. I am well acquainted with the Japanese and English languages;
2. I verified the translation of the above-identified US provisional application from Japanese to English language; and
3. The hereto-attached English translation is a full, true and correct translation of the above-identified US provisional application to the best of my knowledge and belief.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: September 17, 2003 _____

Takahiko MIZOBE

Description

GAS GENERATING COMPOSITION

Technical Field

The present invention relates to a gas generating composition suitable for an air bag restraining system of automobiles and the like, a molded article thereof and an inflator for an air bag using the same.

Background Art

As a gas generating agent for an air bag as a passenger-protecting system in automobiles, a composition using sodium azide has been conventionally used. However, a toxicity to human bodies [LD_{50} (oral-rat) = 27 mg/kg] or hazard in handling of sodium azide has been regarded as a serious problem. Therefore, as safe non-azide based gas generating compositions, gas generating compositions containing various nitrogen-containing organic compounds have been developed to replace the above composition.

US-B 4,909,549 discloses a composition comprising hydrogen-containing tetrazole or triazole compounds and an oxygen-containing oxidizing agent. US-B 4,370,181 discloses a gas generating composition comprising a hydrogen-free bitetrazole metal salt and an oxygen-free oxidizing agent. US-B 4,369,079 discloses a gas generating composition comprising a hydrogen-free bitetrazole metal salt and an alkali metal nitrate, an alkali metal nitrite, an alkaline earth metal

nitrate, an alkaline earth metal nitrite or a mixture thereof. US-B 5,542,999 discloses a gas generating agent comprising a fuel such as GZT, TAGN (triaminoguanidine nitrate), NG (nitroguanidine), NTO and the like, a basic copper nitrate, a catalyst for reducing toxic gases and a coolant. US-B 5,608,183 discloses a gas generating agent comprising a fuel such as guanidine nitrate, a basic copper nitrate and guar gum.

However, the above non-azide based gas generating composition forms residues (mist) after combustion, and thUS-B filter should be used to prevent the mist from flowing into an air bag. In this case, there is a method wherein the gas generating composition has a composition easily forming slag, after combustion, having a shape to be readily captured by the filter.

US-B 6,143,102 discloses that silica is added as a slag-forming agent to a composition comprising a fuel such as guanidine nitrate, a basic copper nitrate and a metal oxide such as alumina, to form excellent slag (clinker).

JP-A No. 10-502610 discloses that glass powder is added to a fuel such as a tetrazole compound and strontium nitrate, thereby lowering the combustion temperature, resulting in a reduction in NOx and CO and formation of solid slag.

US-B 5,104,466 (JP-A 5-70109) discloses that an alkali metal azide, pellets consisting of an oxidizing agent and grains consisting of a silica-containing material are used as a mixture to reduce mist.

Disclosure of the Invention

Accordingly, a purpose of the present invention is to provide a novel gas generating composition forming slag more easily than the above compositions in the prior arts.

As means to solve the problem, the present invention provides a gas generating composition comprising (a) glass powder and (b) aluminum hydroxide.

As another means to solve the problem, the present invention further provides a gas generating composition comprising the following components (a) to (d):

(a) glass powder,

(b) aluminum hydroxide,

(c) an organic compound as fuel, and

(d) an oxygen-containing oxidizing agent.

As still another means to solve the problem, the present invention provides a molded article in the form of a single-perforated cylinder or a perforated (porous) cylinder obtained from the above gas generating composition. The single-perforation or perforation may or may be a through-hole or a hollow.

As still further means to solve the problem, the present invention provides an inflator for an air bag using the gas generating composition or the molded article.

The gas generating composition of the present invention and a molded article thereof contain glass powder, by which combustion residues can be solidified to form a slag, thus preventing the combustion residues from being converted into

mist and released to the outside of an inflator. This effect can further be improved by using glass powder in combination with aluminum hydroxide.

Embodiments of the Invention

The glass powder used as component (a) in the present invention becomes molten upon combustion of the gas generating composition, and is immediately solidified as the temperature is decreased after combustion. In this process, the component (a) melts and solidifies combustion residues derived from other components, thereby trapping the residues to form a slag. Accordingly, the combustion residues are prevented from being converted into mist and released outside an inflator to flow in an air bag.

The glass powder is preferably an amorphous material consisting of a mixture of metal oxides, and the metal oxides are preferably those selected from the group consisting of silicon dioxide, sodium oxide, potassium oxide, calcium oxide, magnesium oxide, barium oxide, lead oxide, boron oxide, aluminum oxide and the like.

The glass powder is preferably one selected from the group consisting of quartz glass, 96% quartz glass, soda lime glass (windowpane, plate glass, bottle glass, glass for light bulb, etc.), lead glass (for electrical, optical and industrial art purposes), aluminoborosilicate glass, borosilicate glass (low expansion, low loss, tungsten sealing, etc.), aluminosilicate glass, etc. In particular, the softening point of such glass

powder is varied depending on its composition, so that it is desirable that the glass powder having the softening point in the optimum range is selected corresponding to the combustion temperature of the composition consisting of an organic compound as fuel, an oxygen-containing oxidizing agent and other additives.

The particle diameter of the glass powder, in terms of 50% particle diameter, is preferably 10 to 300 μm, more preferably 10 to 100 μm, still more preferably 10 to 50 μm.

The content of the glass powder in the gas generating composition is preferably 0.1 to 20% by mass, more preferably 0.5 to 5% by mass. When the content of the glass powder is in the above range, the composition can preferably exhibit the slag-forming action without significantly lowering the efficiency of generation of gas.

Aluminum hydroxide used as component (b) in the present invention is low in toxicity, has a high decomposition starting temperature, and shows a significantly endothermic reaction upon thermal decomposition, to form aluminum oxide and water. It follows that, by incorporation of aluminum hydroxide, the combustion temperature of the gas generating composition is decreased, and after combustion, the formed amount of toxic nitrogen oxides and carbon monoxide is decreased. Together with the glass powder as component (a), aluminum oxide formed by decomposition of aluminum hydroxide acts to form slag.

The content of aluminum hydroxide in the gas generating composition is preferably 0.1 to 20% by mass, more preferably

1 to 15% by mass. When the content of aluminum hydroxide is in the above-described range, the formed amount of toxic nitrogen oxides and carbon monoxide can be reduced as the combustion temperature is lowered, and when the gas generating composition is used in an inflator for an air bag, a burning rate necessary for expanding and developing an air bag in a predetermined time can also be assured.

The gas generating composition of the present invention can be in a four-component system consisting of (a) glass powder, (b) aluminum hydroxide, (c) an organic compound as fuel, and (d) an oxygen-containing oxidizing agent.

The organic compound as fuel of the component (c) is one or at least two selected from tetrazole compounds, guanidine compounds, triazine compounds and nitroamine compounds.

The tetrazole compounds include 5-aminotetrazole, bitetrazole ammonium, etc. The guanidine compounds include guanidine nitrate, mono-, di- or tri-aminoguanidine nitrate, nitroguanidine, etc. The triazine compounds include melamine, cyanuric acid, ammeline, ammelide, ammelande, etc.

The oxygen-containing oxidizing agent as component (d) is one or at least two selected from nitrate, perchlorate, chloric acid, a basic metal nitrate and ammonium nitrate.

The nitrate includes alkali metal nitrates such as potassium nitrate and sodium nitrate and alkaline earth metal nitrates such as strontium nitrate. The perchlorates include potassium perchlorate, sodium perchlorate, magnesium perchlorate, ammonium perchlorate, etc. The basic metal

nitrate includes a basic copper nitrate etc.

When the gas generating composition of the present invention is in a four-component system consisting of the components (a) to (d), the content of component (a) is preferably 0.1 to 20% by mass, more preferably 1 to 10% by mass, the content of component (b) is preferably 0.1 to 20% by mass, more preferably 1 to 15% by mass, the content of component (c) is preferably 30 to 60% by mass, more preferably 35 to 50% by mass, and the content of component (d) is preferably 30 to 60% by mass, more preferably 40 to 55% by mass.

A preferable example of the gas generating composition in a four-component system is a composition comprising (a) glass powder, (b) aluminum hydroxide, (c) guanidine nitrate and (d) a basic copper nitrate. In this case, the content of (a) glass powder is preferably 2 to 6% by mass, the content of (b) aluminum hydroxide is preferably 1 to 10% by mass, the content of (c) guanidine nitrate is preferably 30 to 60% by mass, and the content of (d) a basic copper nitrate is preferably 30 to 60% by mass.

Another preferable example of the gas generating composition in a four-component system is a composition comprising (a) glass powder, (b) aluminum hydroxide, (c) nitroguanidine and (d) a basic copper nitrate. In this case, the content of (a) glass powder is preferably 1 to 5% by mass, the content of (b) aluminum hydroxide is preferably 1 to 15% by mass, the content of (c) nitroguanidine is preferably 25 to 60% by mass, and the content of (d) a basic copper nitrate is

preferably 30 to 60% by mass.

When the gas generating composition of the present invention is in a system containing the component (a) but not a binder, in a system containing the components (a) and (b) but not a binder, in a four-component system containing the components (a) to (d), or in a five-component system containing the components (a) to (d) and the component (f) as an additive, its molded article may, if poor in molding strength, collapse upon actual combustion and burn too acceleratedly to make control of combustion. Accordingly, the binder as component (e) is preferably added.

The binder as component (e) is one or at least two selected from carboxymethyl cellulose (CMC), sodium carboxymethylcellulose (CMCNa), potassium carboxymethylcellulose, carboxymethylcellulose ammonium, cellulose acetate, cellulose acetate butyrate (CAB), methyl cellulose (MC), ethyl cellulose (EC), hydroxyethyl cellulose (HEC), ethylhydroxyethyl cellulose (EHEC), hydroxypropyl cellulose (HPC), carboxymethylethyl cellulose (CMEC), fine crystalline cellulose, polyacrylamide, an aminated product of polyacrylamide, polyacryl hydrazide, a copolymer of acrylamide and a metal acrylate, a copolymer of polyacrylamide and a polyacrylic ester, polyvinyl alcohol, acrylic rubber, guar gum, starch and silicone. Among these, sodium carboyxmethylcellulose (CMCNa) and guar gum are preferable in view of stickiness, cost and ignitability of the binder.

When the gas generating composition of the present

invention is in a system containing the component (a) but not an additive, in a system containing the components (a) and (b) but not an additive, in a four-component system containing the components (a) to (d), or in a five-component system containing the components (a) to (d) and the component (e) as a binder, the additive as component (f) is added preferably for the purpose of assisting the actions of the components (a) and (b).

The additive as component (f) is one or at least two selected from metal oxides such as copper oxide, iron oxide, zinc oxide, cobalt oxide, manganese oxide, molybdenum oxide, nickel oxide, bismuth oxide, gallium oxide, silica and alumina, metal carbonates or basic metal carbonates such as cobalt carbonate, calcium carbonate, magnesium carbonate, a basic zinc carbonate and a basic copper carbonate, composite compounds of metal oxides or hydroxides such as Japanese acid clay, kaolin, talc, bentonite, diatomaceous earth and hydrotalcite, metal acid salts such as sodium silicate, mica molybdate, cobalt molybdate and ammonium molybdate, molybdenum disulfide, calcium stearate, silicon nitride and silicon carbide. These additives can reduce the burning temperature of the gas generating agent, regulate the burning rate and reduce the amount of toxic nitrogen oxides and carbon monoxide formed after combustion.

When the gas generating composition of the present invention is in a five- or six-component system consisting of the components (a) to (f), the content of component (a) is preferably 0.1 to 20% by mass, more preferably 1 to 10% by mass,

the content of component (b) is preferably 0.1 to 20% by mass, more preferably 1 to 15% by mass, the content of component (c) is preferably 5 to 60% by mass, more preferably 10 to 55% by mass, the content of component (d) is preferably 10 to 85% by mass, more preferably 20 to 75% by mass, the content of component (e) is preferably 20% by mass or less, and the content of the component (f) is preferably 20% by mass or less.

A preferable example of the gas generating composition in a five-component system is a composition comprising (a) glass powder, (b) aluminum hydroxide, (c) nitroguanidine, (d) strontium nitrate and (e) sodium carboxymethylcellulose or guar gum.

Another preferable example of the gas generating composition in a five-component system is a composition comprising (a) glass powder, (b) aluminum hydroxide, (c) nitroguanidine, (d) a basic copper nitrate and (e) guar gum.

A still another preferable example of the gas generating composition in a five-component system is a composition comprising (a) glass powder, (b) aluminum hydroxide, (c) melamine, (d) a basic copper nitrate and (e) sodium carboxymethylcellulose or guar gum.

A still another preferable example of the gas generating composition in a five-component system is a composition comprising (a) glass powder, (b) aluminum hydroxide, (c) guanidine nitrate, (d) a basic copper nitrate and (e) sodium carboxymethylcellulose or guar gum.

A preferable example of the gas generating composition

in not less than five-component system is a composition comprising (a) glass powder, (b) aluminum hydroxide, (c) a mixed fuel of two or three components selected from guanidine nitrate, nitroguanidine and melamine, (d) a basic copper nitrate and (e) sodium carboxymethylcellulose or guar gum.

The gas generating composition of the present invention can be molded in a desired shape, and formed into a molded article in the shape of a single-perforated cylinder, a perforated (porous) cylinder or pellets. These molded articles can be produced by a method in which the gas generating composition is mixed with water or an organic solvent and the mixture is extrusion-molded (molded articles in the shape of a single-perforated cylinder and a perforated (porous) cylinder) or by a compression-molding method using a pelletizer (molded article in the shape of pellets).

The gas generating composition of the present invention or the molded article obtained therefrom can be used in, for example, an inflator for an air bag of a driver side, and inflator for an air bag of a passenger side, an inflator for a air bag for a side collision, and inflator for an inflatable curtain, an inflator for a knee bolster, an inflator for an inflatable seat belt, an inflator for a tubular system and a gas generator for pretensioner in various vehicles.

Further, the inflator using the gas generating composition of the present invention or the molded article obtained therefrom may be a pyrotechnic type in which a gas is supplied only from a gas generating agent or a hybrid type in

which a gas is supplied from both of a compressed gas such as argon and a gas generating agent.

Moreover, the gas generating composition of the present invention or the molded article obtained therefrom can also be used as an igniting agent called an enhancer (or a booster) for transferring energy of a detonator or a squib to a gas generating agent.

Examples

The present invention is illustrated more specifically by referring to the following Examples, but the present invention is not limited thereto.

Examples 1 to 4 and Comparative Example 1

Gas generating compositions each having a formulation shown in Table 1 were produced, and each of the gas generating compositions was molded into 2 g of a strand. This strand was installed in a closed bomb having an inner capacity of 1 liter, and the inside of the bomb was purged with nitrogen. Further, the bomb was pressurized up to 6,860 kPa with nitrogen, and the strand was ignited by electrifying a nichrome wire and completely burned. After combustion, combustion residues were collected from the bomb and observed for their state with the naked eye.

In Table 1, GN is guanidine nitrate, BCN is a basic copper nitrate, CMCNa is sodium carboxymethylcellulose, and #1723 and #7056 are glass powders having the following compositions.

#1723 (Aluminosilicate glass; softening point of 908°C) (% by

mass): SiO_2 (57)/Al_2O_3 (16)/B_2O_3 (4)/MgO (7)/CaO (10)/BaO (6)

#7056 (Borosilicate glass; softening point of 718°C) (% by mass): SiO_2 (68)/Al_2O_3 (3)/B_2O_3 (18)/LiO_2 (1)/Na_2O (1)/K_2O (9)

Table 1

	formulation (formulation ratio: mass %)
Example 1	#1723/$Al(OH)_3$/GN/BCN/CMCNa=3/5/38.0/49.0/5
Example 2	#1723/$Al(OH)_3$/GN/BCN/CMCNa=5/5/37.0/48.0/5
Example 3	#7056/$Al(OH)_3$/GN/BCN/CMCNa=3/5/38.0/49.0/5
Example 4	#7056/$Al(OH)_3$/GN/BCN/CMCNa=5/5/37.0/48.0/5
Comparative Example 1	$Al(OH)_3$/GN/BCN/CMCNa=5/39.6/50.4/5

In Examples 1 to 4, the strands after combustion maintained the shape thereof before combustion, but in Comparative Example 1, the strand was finely smashed.

Claims

1. A gas generating composition comprising (a) glass powder and (b) aluminum hydroxide.

2. A gas generating composition comprising the following components (a) to (d):

(a) glass powder,

(b) aluminum hydroxide,

(c) an organic compound as fuel and

(d) an oxygen-containing oxidizing agent.

3. The gas generating composition as claimed in Claim 1 or 2, which further comprises at least one selected from the group consisting of the following components (e) and (f), if required:

(e) a binder and

(f) an additive selected from a metal oxide and a metal carbonate.

4. The gas generating composition as claimed in Claim 3, wherein the content of the component (a) is 0.1 to 20% by mass, the content of the component (b) is 0.1 to 20% by mass, the content of the component (c) is 30 to 60% by mass, the content of the component (d) is 60% by mass or less, the content of the component (e) is 10% by mass or less and the content of the component (f) is 10% by mass or less.

5. The gas generating composition as claimed in Claim 1 or 2, wherein the glass powder as component (a) is an amorphous material consisting of a mixture of metal oxides.

6. The gas generating composition as claimed in Claim 5, wherein the metal oxides are selected from the group consisting of silicon dioxide, sodium oxide, potassium oxide, calcium oxide, magnesium oxide, barium oxide, lead oxide, boron oxide and aluminum oxide.

7. The gas generating composition as claimed in Claim 1 or 2, wherein the glass powder as component (a) is selected from the group consisting of quartz glass, 96% quartz glass, soda lime glass, lead glass, aluminoborosilicate glass, borosilicate glass and aluminosilicate glass.

8. The gas generating composition as claimed in Claim 2, wherein the fuel as component (c) is at least one selected from the group consisting of tetrazole compounds, guanidine compounds, triazine compounds and nitroamine compounds.

9. The gas generating composition as claimed in Claim 2, wherein the oxygen-containing oxidizing agent as component (d) is at least one selected from the group consisting of nitrates, perchlorates, chloric acid, a basic metal nitrate and ammonium nitrate.

10. The gas generating composition as claimed in Claim 3, wherein the binder as component (e) is at least one selected from the group consisting of carboxymethyl cellulose, sodium carboxymethylcellulose, potassium carboxymethylcellulose, carboxymethylcellulose ammonium, cellulose acetate, cellulose acetate butyrate, methyl cellulose, ethyl cellulose, hydroxyethyl cellulose, ethylhydroxyethyl cellulose, hydroxypropyl cellulose, carboxymethylethyl cellulose, fine

crystalline cellulose, polyacrylamide, an aminated product of polyacrylamide, polyacryl hydrazide, a copolymer of an acrylamide and a metal acrylate, a copolymer of polyacrylamide and a polyacrylic ester, polyvinyl alcohol, acrylic rubber, guar gum, starch and silicone.

11. The gas generating composition as claimed in Claim 3, wherein the additive as component (f) is at least one selected from the group consisting of metal oxides including cupric oxide, iron oxide, zinc oxide, cobalt oxide, manganese oxide, molybdenum oxide, nickel oxide, bismuth oxide, gallium oxide, silica or alumina, metal hydroxides including cobalt hydroxide or iron hydroxide, metal carbonates or basic metal carbonates including cobalt carbonate, calcium carbonate, magnesium carbonate, a basic zinc carbonate or a basic copper carbonate, composite compounds of metal oxides or metal hydroxides including Japanese acid clay, kaolin, talc, bentonite, diatomaceous earth or hydrotalcite, metal acid salts including sodium silicate, mica molybdate, cobalt molybdate or ammonium molybdate, silicone, molybdenum disulfide, calcium stearate, silicon nitride and silicon carbide.

12. A gas generating composition comprising glass powder, guanidine nitrate and a basic copper nitrate.

13. A gas generating composition comprising glass powder, a mixed fuel containing guanidine nitrate and a basic copper nitrate.

14. The gas generating composition as claimed in Claim 13, wherein the mixed fuel containing guanidine nitrate is a

mixed fuel of guanidine nitrate and at least one selected from the group consisting of nitroguanidine, melamine, monoaminoguanidine nitrate, diaminoguanidine nitrate and triaminoguanidine nitrate.

15. The gas generating composition as claimed in Claim 12 or 13, which further comprises aluminum hydroxide.

16. A molded article of the gas generating composition being in the shape of a single perforated cylinder or a perforated cylinder, obtained by extrusion-molding the gas generating composition as defined in any one of Claims 1, 2, 12 and 13.

17. An inflator for air bag, using the gas generating composition as defined in any one of Claims 1, 2, 12 and 13.

Abstract

A gas generating composition which can prevent formation of mist is provided. A gas generating composition comprising (a) glass powder, (b) aluminum hydroxide, (c) an organic compound as fuel, and (d) an oxygen-containing oxidizing agent. By the action of the component (a), combustion residues can be solidified to form a slag, thus preventing formation of mist.